Chapter 2 History of Commonwealth marine reserves in Australia and review of the science used for the design of the 2012 reserves

The development of marine protected areas (MPAs) in Australia commenced in 1937 with the declaration of the first Queensland Island National Parks, with protection extending for one mile beyond the low water mark. The Australian and Queensland governments cooperated in establishing the Great Barrier Reef Marine Park (GBRMP) in 1975.

Marine reserves in Commonwealth waters outside of the GBRMP also have a long history, with the Lihou Reef and Coringa-Herald National Nature Reserves (now part of the Coral Sea CMR) proclaimed in 1982 (DoE a).

Subsequently, the number and extent of Commonwealth and state marine reserves have expanded and the Commonwealth's component of Australia's MPA estate now covers approximately 3.2 million km^2, which is about 36 per cent of the waters within the Australian Government's marine jurisdiction. The CMR Review covers those Commonwealth marine reserves (CMRs) in the South-west, North-west, North and Temperate East networks and the Coral Sea reserve—covering an area of approximately 2.4 million km^2.

The design, establishment and management of the CMR estate have been influenced initially by the experience gained through the establishment of GBRMP and the development of marine science in Australia and by international developments in both marine protection and, more generally, biodiversity protection. This extends to the requirements of international treaties to which Australia is a party.

The establishment of the Expert Scientific Panel (ESP) as part of the CMR Review recognises the foundational importance of science to CMR decision-making by the Australian Government. However, the ESP recognises that the interests of industry, recreation, conservation and management will all, rightly, continue to be important considerations in Government decisions on marine reserves into the future. Historical context is important for the ESP, which was asked to consider both the science used to inform the design of the current CMR estate and what science may be needed in the future to 'ensure robust, evidence-based decision-making'. This chapter provides that historical context and, in doing so, addresses the question of the way science was used in establishing the expanded CMR estate in 2012.

2.1 Policy and legal framework

Following the enactment of the *Seas and Submerged Lands Act 1973* and the establishment of the GBRMP in 1975, the ruling of the High Court in 1975 on the *Seas and Submerged Lands Act* and the Offshore Constitutional Settlements reached with the states in the late 1970s set out, among other things, arrangements for:

- the establishment of additional marine parks within Australia's Exclusive Economic Zone (EEZ)
- separately, the management of offshore fisheries (AG 1980).

Marine reserves and fisheries continue to be managed separately and for complementary but distinct purposes in Commonwealth waters. In this context, recreational fishing remains under state jurisdiction (Gullett 2009), generally to the edge of Australia's EEZ. Regulatory arrangements for other activities (commercial fishing and mining being the most extensive) in Australia's offshore waters vary depending on the activity (see appendix 2). However, the Environment Protection and Biodiversity Conservation (EPBC) legislation provides the Director of National Parks with a broad range of controls over activities within CMRs.

Australia ratified the Convention on Biological Diversity (CBD) in 1993, and the 1996 National Strategy for the Conservation of Australia's Biological Diversity (the Biodiversity Strategy) (DEST 1996) was subsequently developed and agreed by Commonwealth, state and territory governments to meet commitments made under the CBD and the Intergovernmental Agreement on the Environment (1992) (CoA 1992). The Biodiversity Strategy included a key objective to establish and manage a comprehensive, adequate and representative (CAR) system of protected areas covering Australia's terrestrial and marine biological diversity.

The Biodiversity Strategy recognised that the existing marine and estuarine MPA system in particular was inadequate to maintain biological diversity. The Biodiversity Strategy recommended expansion of marine parks and reserves to encompass representative examples of Australia's marine environments.

A comprehensive policy for ecosystem-based marine and coastal management was released in 1998 (Australia's Oceans Policy), which set out the framework for integrating regional marine planning with the development of a National Representative System of Marine Protected Areas (NRSMPA) (CoA 1998).

Australia's Oceans Policy included a three-year, $50 million programme for the commencement of regional marine planning, including identifying current and emerging threats to ecosystem health and development of management strategies and frameworks to address them. A key component of the policy was to accelerate development of the NRSMPA, including development of new MPAs and improved management of existing ones for conservation purposes, and to give regional security for industry access to ocean resources (CoA 1998).

Also released in 1998 were the Guidelines for Establishing the National Representative System of Marine Protected Areas (the ANZECC Guidelines) (ANZECC 1998). The ANZECC Guidelines, developed by the Australian and New Zealand Environment and Conservation Council (ANZECC) Task Force on Marine Protected Areas, were prepared to assist government agencies in the development of the NRSMPA and to assist stakeholders in understanding the process. The work of the ANZECC Task Force represented a strong commitment by all Australian governments to the development and implementation of a national network of reserves, with the primary goal being:

to establish and manage a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels (ANZECC 1998).

The ANZECC Guidelines include the CAR principles, described as:

- **Comprehensiveness**: The NRSMPA will include the full range of ecosystems recognised at an appropriate scale within and across each bioregion.
- **Adequacy**: The NRSMPA will have the required level of reservation to ensure the ecological viability and integrity of populations, species and communities.
- **Representativeness**: Areas that are selected for inclusion in MPAs should reasonably reflect the biotic diversity of the marine ecosystems from which they derive.

The ANZECC Guidelines also outline additional principles for the development of the NRSMPA, including a regional framework, the inclusion of highly protected areas (International Union for the Conservation of Nature (IUCN) Categories I and II in each bioregion), use of the precautionary principle (CoA 1992), appropriate consultation to address social, economic and cultural issues as required by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Indigenous involvement (to recognise and incorporate interests of Indigenous peoples) and principles relating to decision-making (integration of long- and short-term environmental, economic, social and equity considerations).

In late 2007, building on lessons learnt from the design and recent proclamation of the South-east CMR Network, the Australian Government published the Goals and principles for the establishment of the National Representative System of Marine Protected Areas in Commonwealth waters (the Goals and Principles) (DoE b) to clarify how the Australian Government was to apply the ANZECC Guidelines to Commonwealth waters. They did not replace the ANZECC Guidelines but, rather, interpreted them to take account of the significant dearth of biological information for offshore and remote waters (the Goals and Principles are discussed in more detail below).

The Oceans Policy laid the foundation for the development of Regional Marine Plans (see section 2.2 below), which have been developed and implemented over the ensuing years, with the South-east Marine Region as the prototype. A 2002 Review of the Implementation of the Oceans Policy (TFG International 2002) noted that the South-east planning process would be an effective template for subsequent plans. Fourteen CMRs were proclaimed by the Australian Government in the South-east Marine Region in 2007 and they continue to be managed by the Director of National Parks in accordance with the EPBC Act and the South-east CMR Network Management Plan, which came into effect in 2014. The South-east CMR Network is not part of the CMR Review but will be a component of any estate-wide CMR planning in the future (in relation to research and monitoring needs, for example) that occurs as a result of the CMR Review.

Figure 2.1 shows the development of the CMR estate from the 1998 release of the Oceans Policy and ANZECC Guidelines through to the proclamation of the new CMRs in 2012.

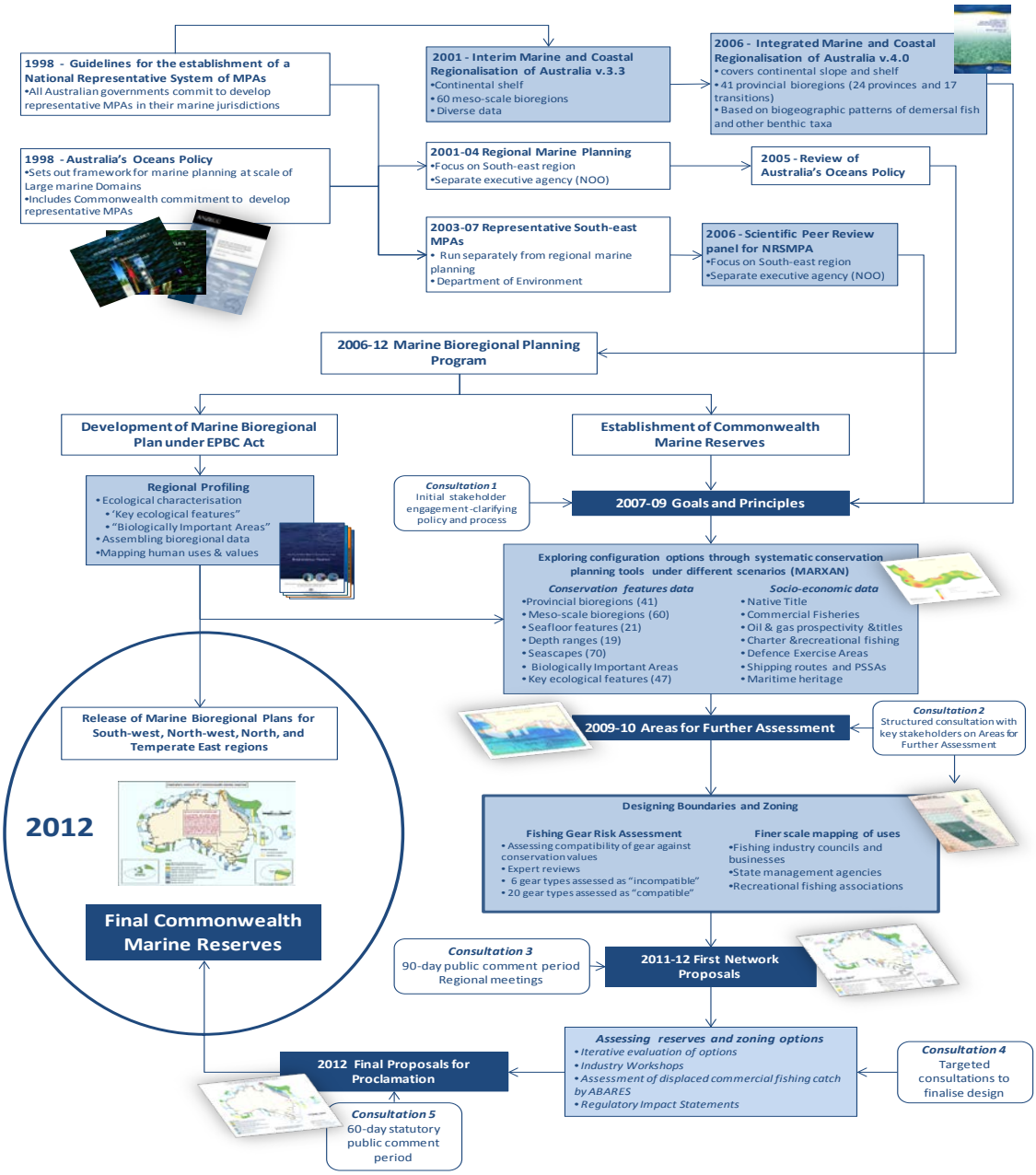

Figure 2.1 The development of Commonwealth marine reserves and marine bioregional planning from 1998 to 2012

The development of Australia's NRSMPA has been a key element in meeting obligations under the CBD. The establishment of the NRSMPA is also consistent with the 2002 World Summit on Sustainable Development (Rio+10) commitment to establishing representative networks of MPAs by 2012. In 2010, Australia and the other parties to the CBD adopted the Aichi Biodiversity Targets. Target 11 is that:

> *by 2020, at least ... 10 per cent of coastal and marine areas especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected*

systems of protected areas and other effective area-based conservation measures. (CBD 2008)

2.2 The science behind the development of Commonwealth marine reserves

2.2.1 Integrated Marine and Coastal Regionalisation of Australia and the use of surrogates

The national network of CMRs aims to represent provincial-scale bioregions recognised in Commonwealth waters, as identified by the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) v4.0 (see box 2.1). These provincial bioregions are the result of detailed compilation and analysis of available scientific information and expert opinion. IMCRA classified Australia's marine environment into 41 distinctive ecological regions (CoA 2006).

Box 2.1 The Integrated Marine and Coastal Regionalisation of Australia and the concept of biodiversity 'surrogates'

In the early 1990s, the Australian Government and the states and territories commenced scientific processes that would contribute to the inshore component of the Integrated Marine and Coastal Regionalisation of Australia (IMCRA). Their purpose was to provide an ecosystem-based scheme that could be used for spatial planning purposes—in particular, the development of the National Representative System of Marine Protected Areas (IMCRA is the marine equivalent of the Interim Biogeographic Regionalisation for Australia, which underpins the National Reserve System on land).

In 1994, relevant Commonwealth agencies (CSIRO and the Australian Geological Survey Organisation) formed a Technical Consortium to develop biophysical regionalisations for offshore waters. The state and Commonwealth groups came together in late 1996 at a national technical meeting to commence integration and in 1998 IMCRA v3.3 was released (IMCRA Technical Group 1998). IMCRA v3.3 was the first layer in a broad ecological planning framework within which more detailed information on ecosystems, communities and/or species distributions can be added to and used to assist decision-making across or within a region (CoA 1998). An updated version of IMCRA (IMCRA v4.0) that extends to Australia's offshore waters was released in 2006 (CoA 2006). This updated version provided a spatial framework for classifying Australia's marine environment into bioregions that 'made sense' ecologically and at a scale useful for regional planning.

A key concept used in IMCRA, and widely applied in conservation planning where direct observations of biodiversity distribution are rarely available, is surrogacy. Surrogates of distribution of biodiversity in the marine environment are usually physical attributes, such as seabed geomorphology or depth, that provide a reasonable proxy for the distribution of biodiversity. Geological and oceanographic surrogates, combined with available data on the biota in some places, were used to underpin the development of IMCRA v4.0, which in turn underpins the design of the CMR networks. Harris *et al.* (2008) provide an overview of the use of surrogates and IMCRA in the establishment of the CMR networks. Key surrogates for Commonwealth marine reserve design are identified in the Goals and principles for the establishment of the National Representative System of Marine Protected Areas in Commonwealth waters.

2.2.2 Marine Bioregional Planning Programme

In 2006, the Australian Government commenced the Marine Bioregional Planning Programme for the South-west, North-west, North and East (covering both the Temperate East and the Coral Sea) regions. The Programme was designed to provide a clearer focus on conservation and sustainable management of Australia's marine environment. It was a process based on the EPBC Act principles of ecologically sustainable development.

The Marine Bioregional Planning Programme was undertaken for Commonwealth waters (generally from three nautical miles offshore to the edge of Australia's EEZ) and sought to deliver on two streams of related but separate information. These were to allow the development of Marine Bioregional Plans under the EPBC Act and the establishment of a network of CMRs in each bioregion.

2.2.3 Marine Bioregional Plans[1]

The Marine Bioregional Plans were developed in consultation with stakeholders and with input from scientists and other experts. There are a number of ways that scientific information was used in the marine bioregional planning process:

- Bioregional Profiles for each marine region were prepared using scientific information about the region's biophysical and socio-economic characteristics and conservation values. For each region, an Ecosystem Report and several Key Species Groups reports were prepared by scientists with relevant disciplinary and regional expertise. These reports were commissioned by the Department and peer reviewed. Scientists were also involved in the identification of key ecological features (KEFs)[2] through regional multidisciplinary workshops. Biologically important areas (BIAs)[3] were defined for listed species through expert scientific input. Information on the socio-economic characteristics of the marine regions was also consolidated by commissioning expert reviews of existing data. The Bioregional Profiles were critical in building the information base for each marine region and a common shared understanding that underpinned subsequent marine reserves design work and consultations.
- As draft Marine Bioregional Plans were developed, scientific information and expertise were used to assess pressures on the conservation values for each marine

[1] This section attributable to DoE c.

[2] **Key ecological features** (KEFs) are elements of the Commonwealth marine environment in the marine regions that, based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity.

[3] **Biologically important areas** (BIAs) are areas where a protected species displays biologically important behaviours such as breeding, foraging, resting and migration. These areas serve to highlight the parts of a marine region that are particularly important for the conservation of protected species. Both the KEFs and BIAs can be viewed on the Department of the Environment's Conservation Values Atlas (DoE d).

region. Scientific information used in assessments included environmental and impact assessment studies, risk assessments, expert advice and research conducted both within Australia and elsewhere. Again, scientists were also involved in the identification of KEFs and BIAs for marine species. The risk assessments and conservation value report cards were independently reviewed by relevant experts.

- In 2011, four draft Marine Bioregional Plans were released, giving scientists and other experts as well as stakeholders and the wider community the opportunity to provide input, including by identifying new and/or more detailed information that would assist in the completion of the plans. This input helped to ensure that the final Marine Bioregional Plans were based on accurate and best-available information and presented a shared understanding of the conservation objectives and priorities within a region.

The available science, expert advice and process used to develop the Marine Bioregional Plans also identified BIAs for marine species and KEFs for each region. This information was used to inform the identification of potential CMRs. Appendix 3 lists the primary scientific and expert reports commissioned by the Australian Government Department of the Environment that were relied upon during the marine bioregional planning process and subsequent CMR design.

2.3 Designing the Commonwealth marine reserves

Key inputs to the design of the CMRs included:

- existing scientific information underlying IMCRA v4.0 (for example, bathymetry, geomorphic features and distribution of endemic biota)
- additional regional information on habitats, species distribution and ecology gathered during the marine bioregional planning process (including the identification of KEFs and BIAs)
- data on the location and distribution of human activities in a marine region
- perspectives of ocean users and other stakeholders in each marine region
- consideration of the contribution that existing spatial management measures can make to the NRSMPA
- consideration of potential management effectiveness (for example, practicality and feasibility of compliance).

2.3.1 The Goals and Principles

The underlying Goals and Principles for CMR design were informed by the available science while recognising from the outset that knowledge of biodiversity in some areas was poor or absent (DoE b). A significant proportion of each marine region is far offshore in very deep waters and these areas had not been the subject of detailed study or data gathering. In these circumstances, existing peer-reviewed data were supplemented with information drawn from known linkages between biodiversity and the physical environment. Where detailed information on species and habitat data was lacking, surrogates for diversity (such as water depth, substrate and geomorphology) were used.

The four Goals provide direction on how to ensure that all types of marine ecosystems and their biodiversity could be represented within the national network of marine reserves.

The 20 Principles provide direction on the location, selection, design and zoning of reserves within networks. Collectively, the Goals and Principles prioritise the placement of reserves in areas that should best represent marine biodiversity but have the least impact on resource users. For example, the Principles state that socio-economic impacts should be minimised and that the regional network should aim to include some highly protected (IUCN I and II) zones within each provincial bioregion.

2.3.2 Areas for Further Assessment

The release of Areas for Further Assessment (AFAs) for public comment in 2009–10 was a first step to assist in the identification of new CMRs, not as the proposed boundaries for new marine reserves but as the areas in which future marine reserves were likely to be located based on outcomes of the marine bioregional planning process that was still under way. Consultations on the AFAs assisted in focusing the attention of stakeholders and identifying potential social and economic impacts and how those impacts could be minimised (DoE e).

Consultations on the AFAs occurred through meetings and targeted data-gathering projects. Detailed information collected through this phase of consultation contributed directly to the process of designing marine reserve network proposals for each marine region. In addition, the information gathered was being used to help minimise potential impacts of marine reserves on parties who use marine resources.

Following on from the AFA process, draft CMR network proposals were developed for each marine region. This involved iterative conservation planning that included further consultation with stakeholders and consideration of threats and possible zoning arrangements.

2.3.3 The science of conservation planning

Conservation planning requires an understanding of spatial configuration of habitats and biota and where conservation efforts are most urgently needed (Grantham *et al.* 2011). The design of MPAs can be informed by identification and mapping of biodiversity hotspots, iconic features (for example, seamounts and reefs); critical habitats for threatened, endangered or protected (TEP) species; and representative habitats (Harris *et al.* 2008). Based on available data and unbiased multivariate classification procedures, maps of seascapes can be produced and combined with maps of geomorphic features (Harris *et al.* 2008; Harris and Whiteway 2009). Software like Marxan (Ball *et al.* 2009; Ball and Possingham 2000), which was used in the design process for the expanded CMR estate, can provide decision support for locating reserves, defining reserve size and generating maps useful for stakeholder consultation (Grantham *et al.* 2011; Ruiz-Frau *et al.* 2015).

Newly developed biological seascapes data was also included in the refinement of CMR design at this stage. Biological seascapes combine biological and physical data to predict the distribution of biodiversity at a finer spatial scale than other IMCRA datasets (Dunstan and

Foster 2009; Ellis *et al*. 2009; Ellis and Pitcher 2009a; Ellis and Pitcher 2009b; Dunstan and Foster 2010a; Dunstan and Foster 2010b; Dunstan and Foster 2010c; Ellis *et al*. 2010).

2.3.4 The approach to zoning

Zoning is a key management tool for protected areas (Kenchington and Day 2011; Shafer 2015), and the EPBC Act (section 346) requires that areas within reserves are assigned to one of the categories defined by the International Union for Conservation of Nature (IUCN). Table 2.1 shows how Australia applies IUCN zoning to its CMRs.

Table 2.1 Commonwealth marine reserve zones and International Union for the Conservation of Nature Categories

CMR zone type	IUCN Category assigned	Assigned IUCN Category description
Sanctuary Zone	IUCN Ia—Strict nature reserve	Managed mainly for science
Marine National Park Zone	IUCN II—National Park	Managed mainly for ecosystem conservation and recreation
Habitat Protection Zone	IUCN IV—Habitat/species management area	Managed mainly for conservation through management intervention
Recreational Use Zone		
Multiple Use Zone	IUCN VI—Managed resource protected area	Managed mainly for the sustainable use of natural ecosystems
General Use Zone		
Special Purpose Zone		

The IUCN's 2012 guidelines provide clear guidance for applying the IUCN Categories to MPAs. Table 2.2 sets out the primary objectives of the IUCN Categories, their applicability to MPAs and the compatibility of activities with each other (Day *et al.* 2012). These IUCN guidelines were used to inform CMR activity matrices, which set out which activities can occur in which CMRs or zones within CMRs. Following development of these matrices, all reserves and zones within reserves were assigned an IUCN Category.

Table 2.2 Matrix of marine activities that may be appropriate for each International Union for the Conservation of Nature Category (after Day *et al.* 2012)

Activities	Ia	Ib	II	III	IV	V	VI
Research: non-extractive	Y*	Y	Y	Y	Y	Y	Y
Non-extractive traditional use	Y*	Y	Y	Y	Y	Y	Y
Restoration/enhancement for conservation (e.g. invasive species control, coral reintroduction)	Y*	*	Y	Y	Y	Y	Y
Traditional fishing/collection in accordance with cultural tradition and use	N	Y*	Y	Y	Y	Y	Y
Non-extractive recreation (e.g. diving)	N	*	Y	Y	Y	Y	Y
Large-scale, low-intensity tourism	N	N	Y	Y	Y	Y	Y
Shipping (except as may be unavoidable under international maritime law)	N	N	Y*	Y*	Y	Y	Y
Problem wildlife management (e.g. shark control programmes)	N	N	Y*	Y*	Y*	Y	Y
Research: extractive	N*	N*	N*	N*	Y	Y	Y
Renewable energy generation	N	N	N	N	Y	Y	Y
Restoration/enhancement for other reasons (e.g. beach replenishment, fish aggregation, artificial reefs)	N	N	N*	N*	Y	Y	Y
Fishing/collection: recreational	N	N	N	N	*	Y	Y
Fishing/collection: long-term and sustainable local fishing practices	N	N	N	N	*	Y	Y
Aquaculture	N	N	N	N	*	Y	Y
Works (e.g. harbours, ports, dredging)	N	N	N	N	*	Y	Y
Untreated waste discharge	N	N	N	N	N	Y	Y
Mining (seafloor as well as sub-seafloor)	N	N	N	N	N	Y*	Y*
Habitation	N*	N*	N*	N*	N*	Y	N*

Key:

No	N
Generally no, unless special circumstances apply	N*
Yes	Y
Yes because no alternative exists, but special approval is essential	Y*
Variable; depends on whether this activity can be managed in such a way that it is compatible with the MPA's objectives	*

2.3.5 Assessing threats to biodiversity

CMRs were not established to mitigate threats to biodiversity, although threat mitigation within reserves is considered in decisions on reserve zoning and the activity matrices that determine what activities can be permitted within zones.

It is important to note that biodiversity conservation objectives inform decisions about whether activities proposed to be undertaken within reserves are compatible with these objectives. In practice, this means that, in assessing activities and their potential impacts

within reserves, greater weight is placed on their impacts on the reserve's conservation value than might otherwise be the case outside the reserve—that is, the 'environmental bar' is higher inside reserves. This principle is articulated in the EPBC Act Policy Statement 1.1—Significant Impact Guidelines, which apply to the assessment of activities with the potential to impact on Matters of National Environmental Significance, including the Commonwealth marine environment (DoE 2013a). The guidelines state that *actions in or near marine protected areas, or other areas with high conservation value, have a greater likelihood of significant impacts on the Commonwealth marine environment* (DoE 2013a).

A zoning framework was developed that took this into account and assessed the compatibility of different activities with the conservation objectives of the zone types proposed in the CMR networks.

Commercial fishing activities were assessed under Fishing Gear Risk Assessments (FGRAs) for all regions. The FGRAs (considered in detail below and in section 3.1) were a key input into the application of Principles 19 and 20 of the Goals and Principles in that they determined the potential risk that fishing gear types pose to marine reserve conservation objectives/values and provided a key input into decisions on whether a fishing activity was compatible with the conservation objectives of a reserve. Fishing was likely to be impacted more than any other marine activity by the introduction of CMRs given the spatial extent of fisheries and impact on marine species and habitats that generally occurs in a consistent way. Commercial fishing covers a larger area more frequently than any other marine activity. These assessments were therefore undertaken early in the CMR design process to ensure that socio-economic impacts on the sector could be minimised.

Recreational fishing, oil and gas, research, tourism and other activities were not assessed in the same generic way as commercial fishing. Decisions were made at the time that broad risk assessments of these activities were not required, in part due to the legislative risk management arrangements (and, in the case of oil and gas and mining, project- and activity-specific risk and impact assessments) that apply to those activities (summarised at appendix 2). Other reasons included:

- other activities (for example, mining, tourism and research) usually being site-specific and generally time-limited in comparison to fishing
- recreational fishing gear types being similar to commercial gear types that were considered 'acceptable' through the FGRA process (and therefore being permitted in all IUCN IV and VI) zones
- international obligations—in relation to shipping, for example.

The ESP is of the view that these decisions were and continue to be sound and that ongoing risk management arrangements (summarised at appendix 2) were, and remain, a sound basis for identifying and managing the risks of activities in CMRs.

Commercial Fishing Gear Risk Assessments

All extractive activities, including commercial fishing, are prohibited in Sanctuary Zones (IUCN Ia) and Marine National Park Zones (IUCN II), but commercial fishing is permissible

in Habitat Protection Zones (IUCN IV) and Multiple Use Zones (IUCN VI) with prescriptions that manage risks associated with the fishing method and gear type (table 2.2).

Commercial fishing in CMRs is regulated primarily under relevant Commonwealth and state/territory fisheries Acts, which generally have objectives that are complementary to the objectives of the EPBC Act. For example, the objectives of the Commonwealth's *Fisheries Management Act 1991* include:

> *ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development (which include the exercise of the precautionary principle), in particular the need to have regard to the impact of fishing activities on non-target species and the long term sustainability of the marine environment.*

As such, the Australian Fisheries Management Authority (AFMA) implements management strategies under an ecosystem-based fisheries management (EBFM) framework that considers the impacts of fishing on:

- target species
- by-product species
- bycatch/discard species
- threatened, endangered and protected species
- habitats and communities.

In CMRs, Commonwealth, state and Northern Territory laws and regulations apply to the extent that they can operate consistently with management plans and broader EPBC legislation (DNP 2013a). Under the EPBC Act, actions for commercial purposes that involve the taking, killing, injuring, moving or keeping of native species in CMRs are subject to the Act and the provisions of management plans.

FGRAs for the South-west Marine Region (DSEWPaC 2010), East Marine Region (Morison and McLoughlin 2010) and the North and North-west Marine Regions (Lack 2010) were based upon findings of the South-east Marine Region Fishing Risk Assessment (SEFRA) in 2005 (E-Systems 2005). This assessment was undertaken by a Technical Working Group of industry and other stakeholders tasked with identifying and categorising risks to benthic conservation values and protected species. Following the SEFRA, AFMA developed an ecological risk management (ERM) framework (see figure 2.2) that details a process for assessing and progressively addressing the impacts that fisheries have on five aspects of the marine ecosystem: target species; by-product and discard species; and TEP species, habitats and communities (AFMA 2010a).

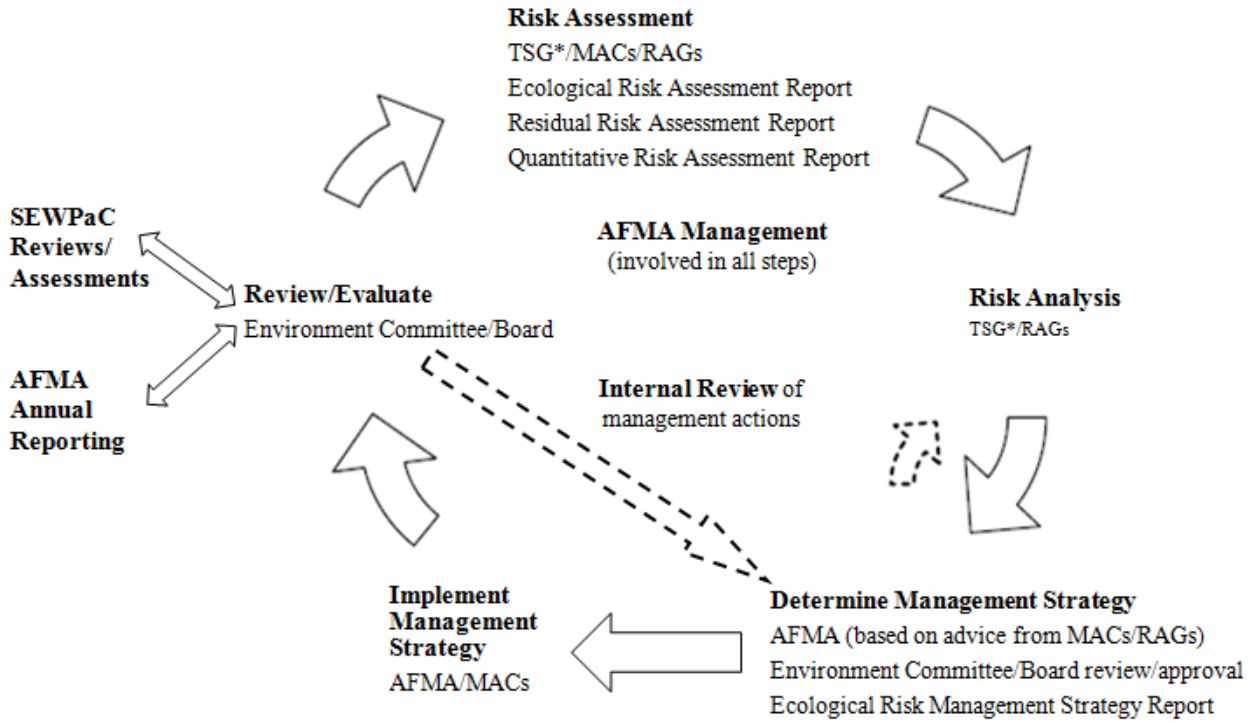

Figure 2.2 Ecological risk management framework (TSG*—Technical Support Group, MACs—Management Advisory Committees, RAGs—Resource Assessment Groups) (after AFMA 2010a).

The FGRAs were desktop analyses that drew on the outcomes of the SEFRA and the results of Ecological Risk Assessments (ERAs) undertaken for Commonwealth fisheries by AFMA. Where appropriate they drew on qualitative Ecologically Sustainable Development Assessments (ESDAs), conducted for state and Northern Territory managed fisheries using the National Ecologically Sustainable Development (ESD) Framework (Fletcher *et al.* 2004). Like the Ecological Risk Assessment for Effects of Fishing (ERAEF) methodology, these involve substantial stakeholder engagement. Finally, they drew on Department of the Environment fisheries assessment reports prepared under the EPBC Act[4] and available information on the management and status of fisheries published by state, Northern Territory and Commonwealth fisheries management agencies.

[4] The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the Australian Government to assess the environmental performance of fisheries and promote ecologically sustainable fisheries management. All export and all Australian Government managed fisheries are subject to assessment under the EPBC Act (see www.environment.gov.au/marine/fisheries) (DoE f).

Australian Fisheries Management Authority Ecological Risk Assessments

ERAs are determined using the ERAEF methodology developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Hobday *et al.* 2007). This process progresses through a number of steps and involves a hierarchy of risk assessment methodologies progressing from a comprehensive but largely qualitative Level 1 Scale Intensity Consequence Analysis (SICA), through a more focused and semi-quantitative Level 2 Productivity Susceptibility Analysis (PSA), to a fully quantitative model-based Sustainability Assessment of Fishing Effects (SAFE) analysis at Level 3 (see figure 2.3). Between Level 2 and Level 3, residual risk assessments evaluate and refine ERA high-risk outcomes by taking into account additional information not considered through the ERA process—in particular, the mitigating effects of some current management arrangements. This approach is a cost and time efficient means of screening out low-risk activities and focusing more intensive and quantitative analyses on those activities assessed as having a greater environmental impact on AFMA managed fisheries resources. It is also precautionary in that risks are scored high in the absence of information, evidence or logical argument to the contrary (Hobday *et al*. 2007).

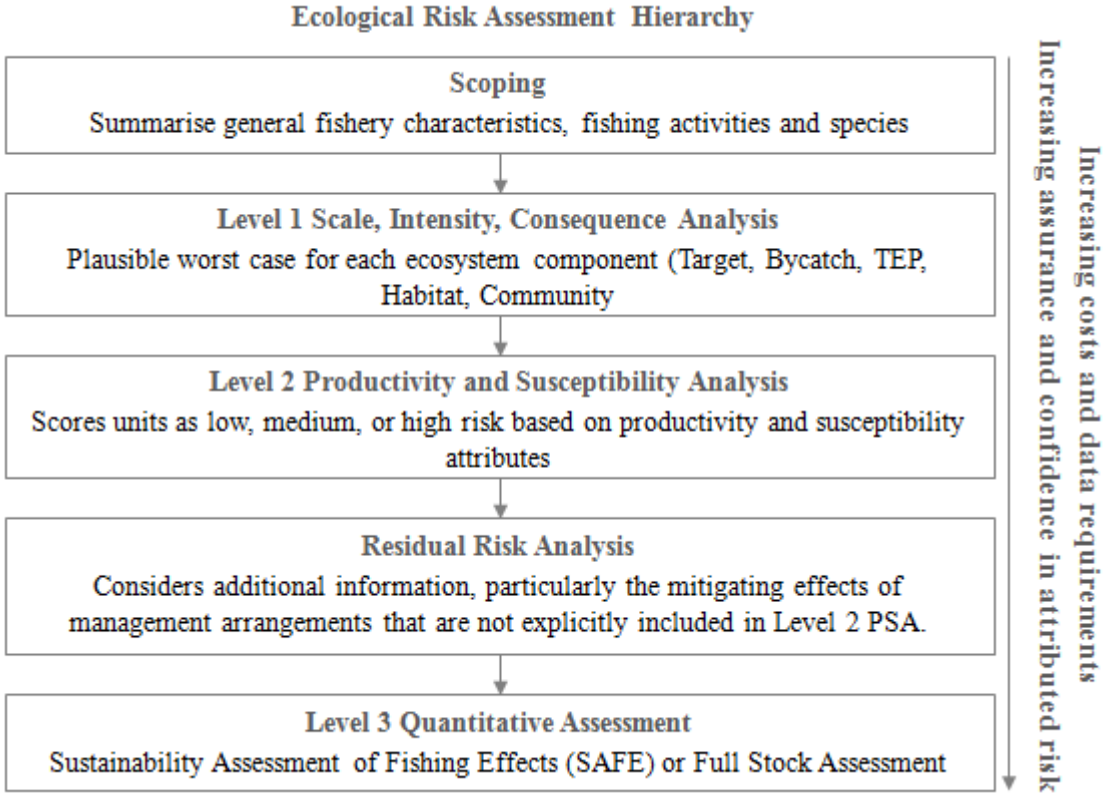

Figure 2.3 Risk assessment hierarchy (after AFMA 2010a)

ERAs have been completed (to varying degrees—either Level 1, 2 or 3) for all major Commonwealth managed fisheries. AFMA's expectation is that each fishery will be periodically reassessed using the ERA methodology in line with the review of any wildlife trade operation (WTO) accreditation in place for the fishery (AFMA 2010a). Approvals of WTOs are made by the Australian Government Minister for the Environment after assessment

of fisheries under the EPBC Act. Most approvals currently in place have a three-year duration.

Translating Ecological Risk Assessments and Ecologically Sustainable Development Assessments into Fishing Gear Risk Assessments ratings

In the South-west, North, North-west and East Marine Region FRGAs, ERA results relevant to a particular gear type were used as the primary basis for assessment rather than the workshop approach used in the South-east. This approach was considered appropriate since CSIRO's ERA process was based on the best available science and expert input as well as extensive stakeholder input.

As described above, the methodology applied also used information from ESDAs and EPBC Act assessment reports (including AFMA and state and Northern Territory government submissions to the EPBC Act assessments) and the latest available information on the management and status of fisheries published by state, Northern Territory and Commonwealth agencies.

Lack (2010) noted, however, that the outputs from these processes vary in both their form and in the rigor underlying them. Some of the issues associated with the use of the outcomes of these different processes included:

- some fisheries have only been subject to the EPBC Act assessments, which do not provide a risk rating
- ESDA risk ratings for fisheries that utilise more than one gear did not always discriminate between gear types
- a very small number of fisheries have not been subject to any of the three assessment processes.

In the absence of risk ratings from ERAs or ESDAs, risks ratings arising from the SEFRA were utilised where they were considered relevant. However, in some cases no relevant risk ratings could be applied and, where no ERA results were available to inform the risk assessment, a more precautionary approach has been taken in interpreting the available information, consistent with Principle 20.

The 'translation' from ERA/ESDA risk ratings to an assessment of acceptability of the method provided the overall FGRA rating for each region. ERA/ESDA risk ratings informed, but did not dictate, the overall FGRA risk rating. An example for the North and North-West is given in table 2.3 (after Lack 2010).

Table 2.3 Relationship between Ecological Risk Assessment/Ecologically Sustainable Development Assessment risk ratings and the North and North-west Marine Regions' acceptability rating

Overall FGRA rating	ERA ratings comparison and policy considerations
Incompatible/Unacceptable	This overall assessment was given to fishing methods when ERAs or ESDAs found that: potential or actual high risk exists for elements of the marine environment that are identified as conservation values to be protected AND for which mitigation measures were not found or are of limited effectiveness. higher levels of precaution were used for those conservation values also identified as regional conservation priorities and where no ERA/FRA was available to inform the assessment.
Incompatible/Unacceptable pending further assessment	This overall assessment was given to fishing methods when ERAs or ESDAs found that: potential or actual high risk exists for elements of the marine environment that are identified as conservation values to be protected AND there is uncertainty about the effectiveness of mitigation measures. higher levels of precaution were used for those conservation values also identified as regional conservation priorities and where no ERA/FRA was available to inform the assessment.
Compatible/Acceptable with mitigation measures and conditions	This overall assessment was given to fishing methods when ERAs or ESDAs found that: a range of risk levels exists for elements of the marine environment that are identified as conservation values to be protected AND for which there are mitigation measures currently in place, or in the process of being implemented, which have been shown to have some effectiveness. higher levels of precaution were used for those conservation values also identified as regional conservation priorities and where no ERA/FRA was available to inform the assessment.
Compatible/Acceptable (some conditions may be required)	This overall assessment was given to fishing methods assessed in the South-east FGRA, ERAs or ESDAs as having a low risk and were not further assessed.

The South-west, North, North-west and East Marine Region FRGAs included quality control reviews undertaken by external independent experts and reviews by experts nominated by the commercial fishing industry (see table 2.4).

Table 2.4 Fishing Gear Risk Assessment quality control reviews

FGRA	Quality control reviews
South-west Marine Region	Smith (2010) *Review of the South-west Fishing Risk Assessment* Knuckey *et al.* (2011) *South-west Bioregion Fishing Gear Risk Assessment review – Report to the National Seafood Industry Alliance* Smith (2011) *Review of the DSEWPaC response to "South-west bioregion fishing gear risk assessment review – report to the National Seafood Industry Alliance"*
East Marine Region	Daley (2010) *Review of East Region Fishing Gear Risk Assessment* Bodsworth and Knuckey (2011) *Review of the Fishing Gear Risk Assessment for the North, North-west and East Marine Regions—Report to the National Seafood Industry Alliance*
North and North-west Marine Regions	Griffiths (2010) *Analytical review of "Assessment of risks that commercial fishing methods may pose to conservation values identified in the Areas for Further Assessment of the North and North-west Marine Regions" for the Department of the Environment, Water, Heritage and the Arts* Bodsworth and Knuckey (2011) *Review of the Fishing Gear Risk Assessment for the North, North-west and East Marine Regions—Report to the National Seafood Industry Alliance*

Evaluating the Fishing Gear Risk Assessments process

The ESP has determined that the process used for the FGRAs was robust and made use of the best information available at the time. This echoes the reviews that were undertaken for the FGRAs, which, while pointing out some inconsistencies, information gaps and areas for improvement, considered that the work done was extensive and detailed and underpinned by a reasonable methodological approach (for example, Knuckey *et al*. 2011; Smith 2010).

The reliance of the FGRAs on findings from the ERAs and, when these were not available in state fisheries, on ESDA assessments was appropriate. Here it is noted that both ERAs and most state ESDAs were undertaken in consultation with industry and other relevant stakeholders. The ESP also considered that the precautionary approach taken in the translation from those findings to a determination of compatibility/acceptability of the fishing methods in CMRs was appropriate given the policy context for the establishment, zoning and management of the CMRs.

The following sections of this report contain further analysis by the ESP of a number of gear types against the new information.

ESP finding

The Expert Scientific Panel concluded that findings of the Fishing Gear Risk Assessments were well founded in the context of the information available at the time they were conducted. However, the Expert Scientific Panel found that a significant amount of research has since been published that is relevant to the assessment of the risk to biodiversity and ecosystems from commercial fishing operations.

2.4 Finalising the Commonwealth marine reserves

Following on from the conservation planning process, CMR network proposals were developed for the South-west, North, North-west, Coral Sea and Temperate East Marine Regions. Public feedback was sought on the proposals between May 2011 and February 2012 (DSEWPaC 2012a). The key elements of the draft network proposals were the outer boundaries and the proposed zoning boundaries within the CMRs. The consultation process for each region lasted 90 days and information resources specific to each proposed network were made available to interested parties. Over half a million submission were received, and the 245 meetings held by the Department of the Environment during the consultation process attracted nearly 2000 attendees.

At this time, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) was engaged to assess the social and economic implications of each of the draft regional CMR network proposals. This work, undertaken with the assistance of the commercial fishing industry, looked at the direct and indirect impacts of the draft network proposals on the fishing industry (including commercial and charter fishing) and the potential impacts on related communities (DoA 2012). Socio-economic effects of marine reserve network proposals on tourism, research, shipping and recreational fishing were not assessed in this way.

2.4.1 Final Commonwealth marine reserve network proposals

Information received through public submissions and stakeholder consultations undertaken between May 2011 and February 2012, together with the socio-economic assessments undertaken by ABARES, were considered by the Government in finalising the CMR network proposals for each region. The combination of these inputs informed refinements made to the final CMR network announced on 14 June 2012 (DSEWPaC 2012a).

A consultation process of 60 days duration was held on the final CMR network proposal between July and September. Consistent with the EPBC Act requirements, the Director of National Parks prepared a report on the comments received, along with the Director's views on them (DNP 2012). The Minister considered this report and a Regulation Impact Statement (DSEWPaC 2012b) before recommending that the Governor-General proclaim the CMRs.

2.4.2 Commonwealth marine reserves proclaimed

The Governor-General's proclamation declaring the new CMRs was registered on the Federal Register of Legislative Instruments on 16 November 2012. The CMRs came into effect on 17 November 2012 along with transitional management arrangements to cover the period during which the statutory management plans are developed and then given effect. The Director of National Parks has responsibility to ensure management plans are in place as soon as practicable. There are no changes for users of these marine reserves until management plans are in place.

2.5 Performance of the proclaimed Commonwealth marine reserve estate against the Goals and Principles

2.5.1 Introduction

The CMR networks under review were declared for the following purposes:

- to protect and maintain biological diversity
- to contribute to the objectives of the NRSMPA, the primary goal of which is to establish and manage a CAR system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels (DNP 2012).

The key objectives of a CAR system are that it is comprehensive (representing the full range of Australia's ecosystems; adequate, in that it includes reserves of appropriate size and configuration to ensure the conservation of marine biodiversity and integrity of ecological processes; and representative, reflecting the marine life and habitats of the area they are chosen to represent) (DNP 2012).

The Goals and Principles (also discussed in section 2.3.1) were developed by the Australian Government to guide the systematic identification of areas representative of the diverse ecosystems and habitats in Commonwealth waters and the design of CMR networks to meet the CAR objectives using biodiversity surrogates. These surrogates include provincial bioregions, depth ranges, key ecological features and seafloor features. This section considers how the CMR estate (excluding the South-east CMR Network, which is not under review) performs against the following Goals and Principles:

- Goal 1—Each provincial bioregion occurring in the marine region should be represented at least once in the marine reserve network. Priority will be given to provincial bioregions not already represented in the National Representative System.
- Goal 2—The marine reserve network should cover all depth ranges occurring in the region or other gradients in light penetration in waters over the continental shelf.

- Goal 3—The marine reserve network should seek to include examples of benthic/demersal biological features (for example, habitats, communities, sub-regional ecosystems, particularly those with high biodiversity value, species richness and endemism) known to occur in the marine region at a broad sub provincial (greater than hundreds of kilometres) scale.

- Goal 4—The marine reserve network should include all types of seafloor features. There are 21 seafloor types across the entire Exclusive Economic Zone. Some provincial bioregions will be characterised by the presence of a certain subset of features, such as continental slope or seamounts.

- Principle 12—Features should be replicated wherever possible within the system, of marine reserves (that is, included more than once)

- Principle 18—The regional marine reserve network will aim to include some highly protected areas (IUCN Categories I and II) in each provincial bioregion.

2.5.2 Overview of the Commonwealth marine reserve estate proclaimed in 2012

A summary of the CMR estate is presented in table 2.5. The CMR estate covers a total area of 2 374 719 km^2, which is 36 per cent of the Commonwealth marine area (6 523 950 km^2). The establishment of this CMR estate as a system of ecologically representative reserves is a major step in addressing the commitment in the CBD 2020 Strategic Plan's Aichi Target 11, which states:

> *By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape.* (CBD 2008)

While the proportion of each network contained in highly protected Sanctuary Zones and Marine National Park Zones ranges from 11 per cent to 51 per cent, the proportion of each CMR region that is contained in highly protected Sanctuary Zones and Marine National Park Zones ranges from three per cent in the North to 51 per cent in the Coral Sea.

Table 2.5 Key figures for Commonwealth marine reserve networks

	South-west[5]	North-west	North[6]	Temperate East	Coral Sea	Total
Area of marine region[7] (km^2)	1 292 015	1 067 731	625 690	1 466 792	989 842	5 442 070
Area of network (km^2)	508 605	335 437	157 483	383 352	989 842	2 374 719
Number of reserves	14	13	8	8	1	44
Proportion of region in the network	36%	37.1%	19.6%	26.1%	100%	43.6%
Proportion of the network in SZ and MNPZ (IUCN Categories I and II)	35.3%	31.1%	10.8%	15.7%	50.8%	36.4%
Proportion of region in SZ and MNPZ (IUCN Categories I and II)	12.7%	9.7%	2.7%	4.1%	50.8%	15.6%

(MNPZ—Marine National Park Zones; SZ—Sanctuary Zones)

[5] These figures include reserves that are in the North-west Marine Region but were subsequently included in the South-west CMR Network for management purposes—specifically the Abrolhos (Kalbarri and Wallaby extensions) CMR, which was included in the South-west CMR Network (as the Abrolhos CMR).

[6] These figures include two reserves that are located within the North-west Marine Region but were subsequently included in the North CMR Network for management purposes—specifically the Joseph Bonaparte Gulf and Oceanic Shoals CMRs.

[7] Referring to the marine regions defined in Commonwealth waters—for example, the South-west Marine Region.

2.5.3 Performance of the Commonwealth marine reserve estate against the Goals and Principles

Provincial bioregions

IMCRA v4.0 defines 41 provincial bioregions for Australia based on geomorphic features and biogeographic patterns in the distribution of bottom-dwelling fish. The first Goal states that each provincial bioregion should be represented at least once in the CMR estate. Of the total number of provincial bioregions, 32 lie within the area covered by the four marine regions and the Coral Sea. Seven of the remaining provincial bioregions are represented in the South-east CMR Network. Two provincial bioregions—Cocos (Keeling) Island Province and Christmas Island Province in the Indian Ocean Territories—are not represented in the CMR estate.

Table 2.6 Performance of the proclaimed Commonwealth marine reserve estate against the Goals and Principles (excluding the South-east Marine Region and the Great Barrier Reef Marine Park)

Goal	Primary conservation feature	Total number	Features represented within estate	Features represented in SZ and MNPZ (IUCN Categories I and II)
1	Provincial bioregions	32	31	26
	Meso-scale bioregions	35	33	21
2	Depth by provincial bioregion	347	325	200
3	Key ecological features	41	39	26
	Biologically informed seascapes	68	60	38
4	Seafloor types	21	21	20
	Total	544	509	331

(MNPZ—Marine National Park Zones; SZ—Sanctuary Zones)

All but one of the 32 provincial bioregions that occur within the four marine regions and the Coral Sea are represented in the proclaimed CMR estate that is the focus of the CMR Review (see table 2.6). The one provincial bioregion not represented is the Southeast Transition, which straddles the Temperate East and South-east regions, but this is included in the East Gippsland CMR, which is part of the South-east CMR Network. Each of these 32 provincial bioregions is therefore represented in the national CMR estate (that includes the South-east CMR Network).

The design and inclusion of CMRs representing the two provincial bioregions in the Indian Ocean Territories will be a further step towards ensuring a comprehensive CMR estate.

Principle 18 for the establishment of the NRSMPA states that *the regional marine reserve network will aim to include some highly protected areas (IUCN Categories I and II) in each provincial bioregion*. Over 80 per cent of provincial bioregions are covered, at least in part, by Sanctuary Zones or Marine National Park Zones and there are six provincial bioregions not represented in a Sanctuary Zone or a Marine National Park Zone.

Meso-scale bioregions

Meso-scale bioregions are defined on the continental shelf using biophysical information and geographic distance along the coast (DEH 2006). IMCRA v4.0 defines 60 meso-scale bioregions, of which 35 fall within the area of the four marine regions and the Coral Sea. Of these, 33 are represented in the proclaimed CMR estate (see table 2.6). Two meso-scale bioregions are not represented in the CMR estate (Groote and Hawkesbury shelves in the North and Temperate East regions respectively). Twenty-one meso-scale bioregions (60 per cent) are represented in Sanctuary or Marine National Park zones.

Depth range by provincial bioregion (Goal 2)

The second Goal states the estate should cover all depth ranges in a region or other gradients in light penetration in waters over the continental shelf. For the design of the CMR estate, 347 water depths by provincial bioregion classes were defined. The proclaimed estate includes 325 of these depth classes (94 per cent), with over half (200) represented in Marine National Park Zones (table 2.6). There are 22 depth classes not represented in the proclaimed CMR estate; however, three are represented in the GBRMP and 14 are represented in the South-east region. The remaining five depth classes are not represented (one each in the South-west, North-west and Temperate East and two in the North). Against this criterion, the estate is not fully comprehensive, although it does include the great majority of water depths.

Key ecological features and biologically informed seascapes[8] (Goal 3)

Over 90 per cent of KEFs and BISs are represented in the CMR estate (table 2.6). This outcome is close to comprehensive, with only two KEFs (Seringapatam Reef and Commonwealth waters in the Scott Reef complex; and Glomar shoals—both in the North-west region) and eight BISs (three in the Temperate East, one in the North-west and four in the South-west regions) not represented anywhere in the CMR estate.

Seafloor types (Goal 4)

Of the 21 seafloor types, all are represented in the CMR estate.

8 **Biological informed seascapes** (BISs) represent a combination of physical and biological information that predicts where species are likely to occur using scientific modelling of ecosystems. The use of these seascapes as surrogates for biodiversity allowed the variety of biodiversity associated with different substrates to be captured within the CMR network.

2.5.4 Summary of Commonwealth marine reserve estate performance

Of the total of 544 primary conservation features defined and identified, 509 (94 per cent) are included in the four marine regional networks and the Coral Sea CMR proclaimed in the CMR estate, excluding the South-east CMR Network. With respect to Goal 1, 31 of 32 provincial bioregions and 33 of 35 meso-scale bioregions are represented in the proclaimed CMR estate (96 per cent coverage overall for Goal 1). Coverage of depth ranges by provincial bioregion (Goal 2) is 94 per cent—325 of the possible total of 347. Goal 3 features are 90 per cent covered and coverage is 100 per cent for Goal 4. Against Principle 18, 70 per cent of provincial bioregions and meso-scale bioregions are represented. Overall, 60 per cent of primary conservation features are in Sanctuary Zones or Marine National Park Zones in the proclaimed CMR estate. These two zones comprise 36.4 per cent of the CMR estate by area and 15.6 per cent of the five regions.

There are 20 primary conservation features not represented in the CMR estate as a whole. The missing features include two provincial bioregions (of the four provincial bioregions missing from the proclaimed estate, one is located in the South-east CMR Network and one is located in the GBRMP), two meso-scale bioregions, seven depth ranges, two key ecological features, and seven biologically informed seascapes. The South-east CMR Network includes 15 conservation features that are shared with the Temperate East region (14 depth ranges and one provincial bioregion).

These figures demonstrate that, while the estate is very largely comprehensive, there are gaps. Some of the gaps in coverage of features in Sanctuary Zones or Marine National Park Zones can be addressed within the outer boundaries of the current CMR estate. Other gaps can only be addressed by extension of outer boundaries of the CMRs and/or by new reserves. Coverage of the provincial bioregions in the Indian Ocean Territories can only be attained through establishment of new reserves.

2.5.5 South-west Commonwealth Marine Reserve Network summary

The South-west CMR Network covers 36 per cent of the South-west region. All provincial bioregions and meso-scale bioregions are represented (Goal 1), and almost all of the other primary conservation features (95 per cent) are included in the network (table 2.7). Only one depth range, four BISs and one seafloor type are not represented in the network (Goals 2, 3 and 4). Of the 124 primary conservation features in the South-west region, 118 are represented in the South-west CMR Network.

All provincial bioregions are represented in Sanctuary Zones or Marine National Park Zones, meeting Principle 18, and 103 (over 80 per cent) of all primary conservation features are represented in these zone types. Sanctuary Zones or Marine National Park Zones cover 35.3 per cent of the area of the network and 13.9 per cent of the region.

Overall, this is comprehensive coverage in terms of the four Goals and Principle 18.

Table 2.7 Performance of the South-west Commonwealth Marine Reserves Network

Goal	Primary conservation feature	Total number	Features* represented within network	Features represented in SZ and MNPZ (IUCN Categories I and II)
1	Provincial bioregions	7	7	7
	Meso-scale bioregions	7	7	7
2	Depth by provincial bioregion	62	61	50
3	Key ecological features	13	13	13
	Biologically informed seascapes	19	15	14
4	Seafloor types	16	15	12
	Total	124	118	103

* This regional summary covers the features occurring in the region. The network also includes features that occur in neighbouring regions because of reserves whose borders extend into other regions (Argo-Rowley CMR includes features in the North-west region but is accounted for in the South-west CMR Network, and features in the North-west region that are included in Argo-Rowley CMR are accounted for in the North-west summary. Western Eyre CMR includes features in the South-east region but is counted in the South-west CMR Network, except for the South-east region features that it includes). This table includes only those features occurring in the South-west region that are represented in network CMRs. For example, two provincial bioregions of the North-west are included in Argo-Rowley CMR but are accounted for in the North-west summary, not the South-west.

(MNPZ—Marine National Park Zones; SZ—Sanctuary Zones)

The average size of the 14 reserves of the South-west is 36 329 km^2, and individual CMR areas range from 630 to 271 898 km^2.

2.5.6 North-west Commonwealth Marine Reserves Network summary

The North-west CMR Network covers 37 per cent of the North-west region. All provincial bioregions and nine of the possible 11 meso-scale bioregions are represented in the North-west CMR Networks. The remaining two meso-scale bioregions are represented in the Oceanic Shoals CMR, which is accounted for in the North CMR Network. Two depth ranges are not captured in the North-west CMR Network. Of these, one is captured in the North CMR Network and one is not captured by any network. Of the 13 KEFs, eight are represented in North-west CMR Network, two are represented in North CMR Network and one is represented in the South-west CMR Network. Of the 20 BISs, 19 are represented in the network and the remaining one is not captured in any CMR. Of the 19 seafloor types in the region, 15 are located in North-west CMR Network and the other four are in CMRs in other networks (table 2.8).

In terms of meeting the Goals and Principles, Goal 1 is met, Goals 2 and 3 are almost met (one depth range, two KEFs and one BIS missing) and Goal 4 is met. Of the 154 primary conservation features in the North-west CMR Network, 140 are in North-west CMRs and 149 are represented in CMRs altogether.

Six of the eight provincial bioregions are represented in Sanctuary Zones or Marine National Park Zones in the North-west CMR Network and one is represented in the South-west CMR Network (Principle 18). Over half of the primary conservation features of the region (77) are represented in these zone types in the North-west CMRs and another seven features are in the zone types in either the South-west or North CMR Networks. These zones comprise 31.1 per cent of the CMR network and 9.7 per cent of the region.

Overall, the outcome in the North-west is close to comprehensive in terms of the four Goals, although addition of the remaining provincial bioregion (Central Western Shelf Transition) would provide a fully comprehensive coverage. The major deficiency in the North-west CMR Network is better coverage of depth ranges in Sanctuary Zones or Marine National Park Zones (nearly half of the 44 depth ranges that are not represented in the network are on the shelf or shelf edge). Addressing this would improve the performance of the North-west CMR Network against Principle 18.

Table 2.8 Performance of the North-west Commonwealth Marine Reserves Network

Goal	Primary conservation feature	Total number	Features* represented within network	Features represented in SZ and MNPZ (IUCN I and II)
1	Provincial bioregions	8	8	6
	Meso-scale bioregions	11	9[1]	5
2	Depth by provincial bioregion	83	81[2]	34
3	Key ecological features	13	8[3]	4
	Biologically informed seascapes	20	19	14
4	Seafloor types	19	15[4]	14
	Total	154	140	77

* This regional summary covers the features occurring in the region. The network also includes features that occur in neighbouring regions because of reserves whose borders extend into other regions.

[1] The two missing meso-scale bioregions are covered in the North CMR Network.

[2] One depth range is captured in the North CMR Network; one is not captured by any network.

[3] Two KEFs are captured in the North and one in the South-west; two North-west KEFs are missing from any network.

[4] All seafloor types are represented in a CMR in the North-west, South-west or North CMR Networks (however, the four features missing from the North-west CMR Network are: Basin, included in the North CMR Network;

Saddle, in the South-west CMR Network (Wallaby Saddle); Sill, in the North CMR Network; and Tidal–sandwave/sandbank, in the Joseph Bonaparte Gulf CMR (North).

(MNPZ—Marine National Park Zones; SZ—Sanctuary Zones)

The average size of the CMRs in the North-west is 25 803 km^2 and individual CMR areas range from 172 to 146 099 km^2.

2.5.7 North Commonwealth Marine Reserves Network summary

The North region is represented in eight CMRs and covers 20 per cent of the North region. The North CMR Network meets Goals 3 and 4, with all KEFs, BISs and seafloor types represented (see table 2.9). In terms of Goal 1, all provincial bioregions are represented in the network, but one meso-scale bioregion (Groote) is missing. Most depth ranges are included in the network, with two missing from any CMR. Of the 86 primary conservation features, 83 are included in the network. In terms of meeting the four Goals this is very good coverage, but a substantially smaller proportion (20 per cent) of the region is within the network—the least coverage of the four networks.

The North CMR Network does not perform well on Principle 18, with only two of the four provincial bioregions included in Sanctuary Zones or Marine National Park Zones. Less than one-third (28) of the 86 primary conservation features are represented in these zones, with depth ranges (four out of 24) and BISs (six out of 20) particularly poorly covered. Overall, only 10.8 per cent of the network and 2.7 per cent of the region is in Sanctuary Zones or Marine National Park Zones—the lowest proportions in the CMR estate. As no-take zones are key elements within CMR network design, this outcome was seen to be unsatisfactory.

The average size of the CMRs in the North CMR Network is 19 685 km^2, ranging in area from 1399 to 71 743 km^2.

Table 2.9 Performance of the North Commonwealth Marine Reserves Network

Goal	Primary Conservation Feature	Total number	Features represented within network	Features represented in SZ and MNPZ (IUCN I and II)
1	Provincial bioregions	4	4	2
	Meso-scale bioregions	15	14	6
2	Depth by provincial bioregion	24	22	4
3	Key ecological features	8	8	3
	Biologically informed seascapes	20	20	6
4	Seafloor types	15	15	7
	Total	86	83	28

(MNPZ—Marine National Park Zones; SZ—Sanctuary Zones)

2.5.8 Coral Sea Commonwealth Marine Reserve summary

The Coral Sea CMR covers the entire Coral Sea region and therefore meets all four of the Goals. At 989 842 km^2, it is a very large reserve by global standards.

It is close to meeting Principle 18 (five of six provincial bioregions in Marine National Park Zones) (see table 2.10). The one provincial bioregion (Central Eastern Transition) not represented in a Marine National Park Zone in the Coral Sea CMR is well represented in a GBRMP green zone. The one seafloor type not represented in Coral Sea Marine National Park Zone is represented in the Marine National Park Zone of the Central Eastern CMR in the Temperate East CMR Network.

The proportion of the CMR that is included in Marine National Park Zone (51 per cent) is the highest in the CMR estate. With 93 of a possible 119 primary conservation features represented in Marine National Park Zones, including 15 of 16 seafloor types, coverage of these features in Marine National Park Zones is very good. The majority of features not represented in Coral Sea Marine National Park Zones are depth ranges. Of the 24 depth ranges not represented, 23 are within two provincial bioregions (Cape Province in the north and Central Eastern Transition in the south). Most of these are shallower shelf and slope depth ranges and many are represented in GBRMP green zones. Nonetheless, the majority of Marine National Park Zones coverage of primary conservation features of the Coral Sea CMR is in the deeper waters of the reserve, and the only complementarity with adjacent GBRMP green zones occurs in the far north of the reserve.

The Coral Sea CMR bears some similarities with the four networks in terms of representativeness, with Marine National Park Zones covering large expanses of deep water, and with shallower depths and continental shelf in particular less well represented.

Table 2.10 Performance of the Coral Sea Commonwealth Marine Reserve

Goal	Primary conservation feature	Total number	Features represented within network	Features represented in SZ and MNPZ (IUCN I and II)
1	Provincial bioregions	6	6	5
	Meso-scale bioregions	–	–	–
2	Depth by provincial bioregion	94	94	70
3	Key ecological features	3	3	3
	Biologically informed seascapes	–	–	–
4	Seafloor types	16	16	15
	Total	119	119	93

(MNPZ—Marine National Park Zones; SZ—Sanctuary Zones)

2.5.9 Temperate East Commonwealth Marine Reserves Network summary

The Temperate East is the least comprehensive of the CMR estate, with 26 per cent of the Temperate East region in the network and 110 of the 155 primary conservation features in the region represented in the network (see table 2.11). While seven of 10 provincial bioregions are represented in the Temperate East CMRs, the remaining three are represented elsewhere in the CMR estate, with two in the Coral Sea and one in the South-east CMR Network. One meso-scale bioregion (Hawkesbury Shelf) is not represented in any CMR. The Temperate East CMR Network could be regarded as nearly meeting Goal 1.

The Temperate East CMR Network performs poorly on depth representation (Goal 2), with 36 depth ranges missing (one-third of the 109 depth ranges; however, three are represented in GBRMP, 17 in the Coral Sea CMR, 14 in South-east CMRs and one in state waters, leaving only one depth range missing entirely from the CMR network). Depth ranges comprise the majority of the 45 features in the region missing from the Temperate East CMRs. All KEFs and six out of nine BISs are better represented (Goal 3—80 per cent met), as are seafloor types (Goal 4—88 per cent included).

Representation of provincial bioregions (four out of 10) and primary conservation features (56 out of 155) in Sanctuary Zones or Marine National Park Zones is low, with 15.7 per cent of the network and 4.1 per cent of the region included in Sanctuary Zones or Marine National Park Zones.

Against these metrics, and especially in comparison to other networks, the Temperate East CMR Network performs poorly against the Goals and Principles. The major deficiency in representation is coverage on the continental shelf and representation of conservation features

in Sanctuary Zones or Marine National Park Zones, most notably the three provincial bioregions that are primarily located on the continental shelf.

The average size of eight CMRs in the Temperate East is 47 919 km^2—the largest of the four networks—and individual CMR areas range from four to 188 443 km^2.

Table 2.11 Performance of the Temperate East Commonwealth Marine Reserves Network

Goal	Primary conservation feature	Total number	Features represented within network	Features represented in SZ and MNPZ (IUCN I and II)
1	Provincial bioregions	10	7	4
	Meso-scale bioregions	4	3	1
2	Depth by provincial bioregion	109	73	35
3	Key ecological features	6	6	4
	Biologically informed seascapes	9	6	1
4	Seafloor types	17	15	11
	Total	155	110	56

(MNPZ—Marine National Park Zones; SZ—Sanctuary Zones)

2.5.10 Discussion and findings

Comprehensiveness and representativeness

Overall, the proclaimed CMR estate includes the vast majority of the biodiversity surrogates (primary conservation features) on which the design of the networks was based. Measured against the four Goals it is largely comprehensive but with the Temperate East region the least comprehensive.

The Temperate East and North CMR Networks cover the smallest proportion of their regions and include the lowest proportion of network and region in Sanctuary Zones or Marine National Park Zones, contrasting with Marine National Park Zone coverage in the South-west and North-west CMR Networks.

The Goals and Principles recognise that there are constraints, especially socio-economic constraints, that must be balanced in designing a reserve network. The effects of these constraints, and minimising socio-economic costs, is most apparent when considering the design of the Temperate East CMR Network overall and the location and coverage of Marine National Park Zones in the Temperate East and North CMR Networks, but this is also apparent in the Coral Sea. Broadly, what is missing or deficient is coverage by CMRs and

Marine National Park Zones on the continental shelf, which reflects the greater use and immediate economic value of these waters.

For these reasons in particular, the CMR estate has attracted criticism from members of the scientific community for failing to meet CAR objectives. Examples of criticisms include extent of coverage (Barr and Possingham 2013; Hobbs 2014; Grech *et al.* 2014); adequacy of protection for threatened species (for example, Devitt *et al.* 2015); governance and process (for example, Vince 2014); lack of integration and loss of coherence and complementarity with state MPA planning processes and MPAs (for example, Vince *et al.* 2015); and the approach taken on socio-economic assessment and impacts on the fishing industry (Ernst and Young 2012). Some of these criticisms are valid, as shown above. However, broad statements about representation of conservation features and lack of comprehensiveness are not consistent with the above assessment when considering the overall CMR estate.

The analysis of representativeness of the national MPA estate, including state and territory waters and the GBRMPA, by Barr and Possingham (2013) was based on representation of IMCRA bioregions, some of the geomorphic and ecological features in each CMR planning region (but not consistently between regions) and four types of seafloor topography as bathymetric classes: continental shelf, continental slope, continental rise, and abyssal plain. As described elsewhere in this report, the approach taken to design the CMR network involved the use of a wide range of biodiversity surrogates, including 347 depth ranges. The analysis of Barr and Possingham (*op. cit.*) included a measure (protection equality) of how equal representation is between regions. They concluded, on this basis of these criteria and focusing on no-take zones, that the proclaimed estate did not meet the basic measures of representation. Some of their criticism, echoed by others, is the absence of quantitative targets in the design of the CMR estate and especially for representativeness or coverage by no-take areas. Much of this criticism is valid and is generally consistent with the performance assessment in this section, particularly in terms of representation of continental shelf in no-take zones.

The assessment in this section identifies the North and Temperate East regions as the least comprehensively covered by the CMR networks. However, it should be noted that there is some complexity in comparing past analyses that examine the proclaimed CMR estate network by network (or region by region), as the figures depend on which network is regarded as including particular CMRs. Oceanic Shoals, which extends across the North-west and North regions, is regarded in the analysis in this section as occurring in the North region, and the Abrolhos CMR, which extends from the South-west into the North-west region, is included in the South-west calculations. An additional complexity in taking a region-by-region approach is that some features, notably provincial bioregions and depth ranges, extend across regions and could be double-counted if an overall picture is produced by simply summing the outcomes from each region.

The observation by Hobbs (2014) that the Indian Ocean Territories that include Christmas Island and the Cocos (Keeling) Islands were not included at all in the design of the proclaimed estate is evident. This is a gap in conservation planning and the

comprehensiveness of the CMR estate. While some preliminary assessment had been conducted for the Government on the conservation values of the region as a basis for the design of a CMR network in the Indian Ocean Territories (Brewer *et al.* 2009), this did not advance to a proposed network.

In one of the few analyses published on threatened species in marine reserves in Australia, Devitt *et al.* (2015) assessed the adequacy of protection of four species of sawfish—arguably the most threatened group of marine fishes (Faria *et al.* 2013; Dulvy *et al.* 2014)—and concluded that marine protection targets had been met for all four species.

Adequacy

The core element of adequacy is the extent to which a reserve or network has long-term viability. Persistence, integrity and resilience are key concepts underpinning adequacy of a reserve network. Well-designed systems of individual reserves are generally considered to be superior to isolated individual reserves, as they can provide meaningful spatial relationships amongst sites for the maintenance of ecosystems and connectivity and offset the effects of local catastrophes (McCook *et al.* 2010; Rice and Houston 2011; Grorud-Colvert *et al.* 2014; Lagabrielle *et al.* 2014). Two key design features for adequacy are replication and size (that they are large enough for natural processes to persist and that the populations, communities and species protected are ecologically viable) (ANZECC 1998). Replication improves the likelihood of regional persistence, spreading the risk of failure by providing greater opportunity for recolonisation from other viable and connected areas (Magris *et al.* 2014). Large protected areas are generally held to be more effective for biodiversity conservation than small areas, as more species and associated ecosystem processes will be protected in a larger area and individual species are more likely to have their critical life stages protected (Edgar *et al.* 2014)—although, as discussed in chapter 3, the science underpinning the adequacy and size of no-take areas is a matter of debate.

The size of the individual 44 CMRs in the proclaimed estate ranges from four to 989 842 km^2, with a mean area of 53 971 km^2 and a median area of 6217 km^2. All but one of the 44 CMRs that comprise the four networks and the Coral Sea CMR are larger than the 100 km^2 minimum size suggested by Edgar *et al.* (2014). Given the dimensions and location of the majority of the CMRs, and their overall coverage of over one-third of the marine area, size is likely to be more important than replication in contributing to the adequacy of the CMR estate. These new CMRs are very large in comparison with the vast majority of the marine protected areas and no-take reserves that have been studied and reported in the scientific literature. Studies on the efficacy of very large pelagic reserves (greater than 100 000 km^2) are in their infancy, as most of these very large reserves have only recently been established.

In summary, while the establishment of the CMR estate through the four networks and the Coral Sea CMR proclaimed in 2012 and the South-east CMR Network proclaimed in 2007 represents the most extensive and comprehensive 'whole-of-ocean' approach to marine conservation by any country, there are some gaps to be addressed in due course. In terms of the CBD Aichi Target 11, the most significant issue ahead is to ensure that the key element of

that target, that the reserves are 'effectively and equitably managed', is clearly and resolutely addressed.

ESP finding

The proclaimed Commonwealth marine reserve (CMR) estate constitutes a credible outcome based on biodiversity surrogates that are, in the great majority, represented in the CMR networks and CMRs.

Some significant gaps in coverage exist and should be addressed in due course to ensure a more comprehensive and adequate inclusion of a representative sample of Australia's marine biodiversity in the national CMR estate.

The Expert Scientific Panel recognises the constraints on CMR design from socio-economic factors that have limited the capacity to obtain full representation of all surrogates within the CMR estate and that these factors will remain limitations given the importance of continuity of access for many users of the marine environment. However, the ESP encourages the current and successive governments to address the significant shortfalls in representativeness of the CMR estate as opportunities arise and during future planning cycles, with a priority on amending the outer boundaries of existing CMRs and/or designing new reserves to improve representation in the Temperate East Marine Region and Indian Ocean Territories in particular.

2.6 Conclusions

In light of the information set out in this chapter and appendix 2, the ESP is of the view that the CMR estate makes a significant contribution to the NRSMPA, though there are areas that can be improved in the Temperate East CMR Network and the provincial bioregions associated with Australia's Indian Ocean territories that were not considered as part of the Marine Bioregional Planning Programme.

Based on the information available at the time:

- The marine bioregional planning process, which was underpinned by IMCRA and the use of surrogates and complemented by scientific workshops and literature review, was a sound basis for designing the CMRs that were proclaimed in 2012.
- The process for determining fishing gear risk was appropriate.
- The risk management processes in place for activities in CMRs were appropriate.

Notwithstanding these conclusions, a number of areas of contention have been identified since the CMRs were proclaimed. Those areas of contention which relate to the science underpinning zoning and allowed uses for the CMRs have been addressed by the ESP, in response to requests for advice from the BAP, in chapter 3 of this report.